XXXIII.—*On the Fossils of the Hunstanton Red Rock.*

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The evidence of a rock's age derived from fossils can never be quite conclusive, and never rank as equal in value with sectional evidence; for the testimony of different species is of unequal importance. And so the opinion formed from a mere glance at the *facies* of a fauna may be of more value than elaborate tables of the range of species. In this way the Red Rock fossils may be said to have an Upper-Greensand character, with some resemblance to Gault; but the same thing would be remarked, only on the latter clause more emphatically, of the Cambridge Greensand.

The fossils in the annexed list are all from Hunstanton, and my own collecting: they are to be seen in the Woodwardian Museum.

The rock is divided into three well-marked layers, nearly equal in thickness. In descending order, they are numbered 1, 2, 3; and in the fifth column of the table a first attempt is made to refer the species to their places in the section.

	Chalk.	Upper Greensand.	Peculiar.	Gault.	Bed
Polyptychodon					
Ichthyosaurus campylodon, *Ctr.*	*	*	..	..	3
Otodus appendiculatus, *Ag.*	*	*	..	..	3
Edaphodus Huxleyi, *Seel.*	..	..	*	..	3
Ischyodus	..	*			
Belemnites attenuatus, *Sow.*	..	..	..	*	all
Belemnites minimus, *Sow.*	..	*	..	*	all
Ammonites splendens, *Sow.*	..	*	..	*	3
Ammonites Studeri, *Pictet*	..	*	..	..	3
Ammonites serratus, *Park.*	..	*	..	*	3
Ammonites Guersantii, *Pictet*	..	*	..	*	3
Ammonites rostratus, *Sow.*	*	*	..	*	2
——— ———, var.	..	..	*		
Ammonites ochetonotus, *Seel.*	..	..	*	..	2
Ammonites solenonotus, *Seel.*	..	..	*	..	2
Ammonites sphærotus, *Seel.*	..	..	*	..	2
Ammonites proboscideus, *Sow.*	..	..	..	*	3
?Crioceras occultus, *Seel.*	..	..	*		
Nautilus simplex, *Sow.*	..	*	..	..	2, 3
Rostellaria Parkinsoni, *Sow.*	*	*	..	*	3
Pleurotomaria Emarginula	..	..	*		
Cerithium ornatissimum, *Desh.*	*	*	..	*	3
Plicatula minuta, *Seel.*	..	*	..	..	1
Plicatula sigillina, *Woodw.*	*	*	..	..	all

* Communicated by the author, having been read before the Cambridge Philosophical Society.

	Chalk.	Upper Green-sand.	Peculiar.	Gault.	Bed.
Plicatula inflata, *Sow.*	*	*			
Spondylus latus, *Sow.*	*	*			
Spondylus Dutemplianus, *D'Orb.*.	*	*			
Spondylus truncatus, *Goldf.*	*	*			
Ostrea vesiculosa, *Lam.*	*	*			
Ostrea curvirostris, *Nils.*	*				
Ostrea biauriculata, *Lam.*		*			
?Ostrea Normaniana, *D'Orb.*	*	*			
Ostrea hippopodium?, *Nils.*	*	*			
Exogyra conica?, *Sow.*	*	*	..	*	
Exogyra Couloni, *Def.*	..	*			
Exogyra Rauliniana, *D'Orb.*	..	*	..	*	
Exogyra haliotoidea, *Lam.*	..	*			
Exogyra laciniata, *Nils.*	*	*			
Exogyra Rauliniana, var.	..	*			
Pecten Beaveri, *Sow.*	*	*	..	*	
Pecten Cenomanensis, *D'Orb.*	..	*			
Hinnites trilinearis, *Seel.*	..	*			
Hinnites Salteri, *Seel.*	..	..	*		
Neithea quinquecostata, *Sow.*	*	*	..	..	3
Perna sulcata, *Sow.*	..	*	..	*	2, 3
Perna concentrica, *Sow.*	*	*	..	*	
Perna tenuis, *Mant.*	*				
Perna Crispii, *Mant.*	*	*			
Perna					
Perna plana, *Seel.*	..	..	*		
Perna transversa, *Seel.*	..	..	*	..	3
Avicula cuneata, *Seel.*	..	..	*		
Avicula gryphæoides, *Sow.*	*	*	..	..	1
?Trigonia Hunstantonensis, *Seel.*..	..	..	*		
Exogyra ungula, *Seel.*	..	..	*		
Exogyra arcula, *Seel.*	..	..	*		
Lima globosa, *Sow.*	*	*	..	..	1
Teredo					
Kingena lima, *Def.*	*	*	..	*	
Crania Parisiensis, *Def.*	*	*	..	..	2
Terebratulina gracilis, *Schl.*	*	*	..	*	1
Terebratulina striata, *Wahl.*	*	*	..	..	3
Terebratula capillata, *Def.*	..	*	..	..	all
Terebratula biplicata, *Broc.*	*	*	..	..	all
Terebratula Dutempliana, *D'Orb.*.	..	*	..	..	all
Rhynchonella lineolata, *Phill.*	..	*	..	..	2, 3
Rhynchonella Cuvieri, *D'Orb.*	*	..	..	..	1
Rhynchonella sulcata, *Park.*	..	*	..	..	2
Cardiaster suborbicularis, *Def.*	..	*	..	..	2, 3
Cardiaster, *var.* β	..	..	*		
Cardiaster, *var.* γ	..	..	*		
Koninckocrinus Agassizi, *Seel.*	..	..	*	..	2, 3
Koninckocrinus rugosus	..	..	*		
Pentacrinus Fittoni, *Aust.*	*	*	..	*	
Pentacrinus					
Cidaris vesiculosa, *Goldf.*	..	*	..	..	3

	Chalk.	Upper Green-sand.	Peculiar.	Gault.	Bed.
Cidaris					
Cidaris					
Diadema scriptum, *Seel.*	..	*			
Hyposalenia Wiltshirei, *Seel.*	..	..	*	..	3
Astrogonium					
Sellignota major, *Seel.*	..	*	..	..	3
Pollicipes glaber, *Rœmer*	*	*	..	..	1
Remains of a Crustacean					
Bernericea polystoma, *Rœm.*	..	..	..	..	2
Bernericea contracta, *Seel.*	..	..	*		
Bernericea Clementina, *D'Orb.*	..	..	..	*	
Proboscina dilatata, *D'Orb.*	..	*			
Cellulipora sulcata, *Seel.*	..	..	*		
Reptemulticava n. sp.	..	*			
Reptotubigera serpens, *D'Orb.*	*				
Vermicularia Phillipsii, *Sow.*					
Serpula antiqua, *Sow.*	*	*	..	*	
Serpula umbonata, *Sow.*	*	*	..	*	
Serpula helix, *Seel.*	..	..	*	..	3
Serpula	..	..	*		
Serpula	..	..	*		
Serpula	..	..	*		
Ventriculites	..	..	..	..	2
Brachiolites labyrinthicus, *Mant.*	*				
Cephalites					
Siphonia costata, *Lamx.*, var.	..	*	..	..	2
Chenendopora expansa, *Ben.*, var.	..	*	..	..	2
Scyphia tessellata, *Seel.*	..	*	..	..	2
Scyphia, n. sp.	..	..	*		
Coscinopora quincuncialis	..	..	*		
Spongia paradoxica	..	..	*		

The results of this table may be stated in another.

	Vertebrata.	Encephala.	Lamellibranchs.	Brachiopoda.	Echinodermata.	Polyzoa.	Articulata.	Actinozoa.	Amorphozoa.
Chalk	2	3	18	6	1	1	3	0	1
Upper Greensand	3	9	25	9	5	2	3	0	3
Gault	0	9	5	3	1	1	2	0	0
Peculiar	1	6	7	0	5	2	1	3	3

Prof. Phillips, talking over this matter of the age of the Hunstanton Rock, remarked that he was far from having perfect faith in the results of the system of counting heads. And

naturally; for if the existence and origin of species should be due to the continuous action of physiological laws, then, seeing that differentiation goes on in a sort of increasing geometrical proportion with every successive elaboration of fundamental organic structures, it will be evident that (supposing groups to be always founded on characters equally important) the duration of the genus or species in time will be directly as its degradation. Consequently species of Vertebrata equal in value with species of Mollusca would mark the age with greater certainty. Hence until characters are coordinated and the relative duration of species worked out, no very determinate conclusion will ensue from the counting of heads.

And there is nothing to show that, because the agencies which accumulated strata in a given area ceased, therefore the life in that area became extinct; for the superposition of a distinct deposit can never *necessitate* a different set of fossils. And as no physical change can operate simultaneously over more than a part of the globe, there must always be a portion of the circumference of the disturbed area where the forms of life will be scarcely if at all affected. And just as, in modern migrations of animals in space, instances occur where some are cut off from the main body and retained in what now seems an unnatural habitat, so must it sometimes in olden times have happened that a smaller or larger body, or all the forms of life of an area, became land-locked, and therefore the species elsewhere characteristic of different deposits would sometimes occur mixed in the same stratum. Hence in cases where fossils hitherto peculiar to any given bed occur in new combinations, their value in fixing the age of the stratum must generally be dubious.

In every class a majority of the fossils was previously known from the Upper Greensand; so it is evident that the fossils indicate a greater affinity with that stratum than with any other. But as there are Gault fossils, and they occur at the base, it is possible that the base of the bed may be older than ordinary Greensand, and bridge over the interval indicated by the change of the Gault to Greensand. Similarly, as there are Chalk fossils, it is possible that the upper part of the bed may be newer than the Greensand elsewhere, and bridge over the gap between that deposit and the Chalk-marl. So the Hunstanton Rock might probably be the most perfect exhibition of the Upper Greensand that is known. Of the named fossils, 58 are Upper Greensand forms, 35 occur in the Chalk, and 21 in the Gault.

But, to see the real value of numbers like those of Gault Cephalopods and Chalk bivalves in the table, it must be seen how

many of the species have hitherto been *peculiar* to the several strata. This is here shown.

	Vertebrata.	Encephala.	Lamellibranchs.	Brachiopods.	Polyzoa.	Echinoderms.	Articulata.	Actinozoa.	Amorphozoa.	Total.
Chalk.....	0	0	2	1	1	0	0	0	1	5
Upper Greensand	1	2	8	4	2	4	0	0	3	24
Gault.....	0	2	0	0	1	0	0	0	0	3
Hunstanton Rock	1	6	7	0	2	5	1	3	3	28

So far as life-evidence can be trusted, this table demonstrates the Hunstanton Rock to be Upper Greensand. With 24 Greensand species, and only 5 Chalk forms, and 3 Gault forms, the affinity of the bed with the latter deposits must be very slight, and need not be anything at all. Hence, and especially as most of them come from the middle of the stratum, the species *peculiar* to the Hunstanton Rock must be regarded as species peculiar to the Upper Greensand.

And when it is remembered how many of the fossils of most Greensand localities had previously only been known from the Chalk or Gault, the proportion here is singularly small. Even in this section there are 14 Greensand species which, since they are also Chalk species, may, at one period of our knowledge, have been peculiar to the Chalk; while there are 3 which, for the same reason, may have appeared to be peculiar to the Gault. Therefore there is *nothing* in the fossils to distinguish this deposit from the Upper Greensand of other localities: to the palæontologist the Hunstanton Red Rock is a northern extension of the Upper Greensand.

XXXIV.—*On the Influence of the Nervous System on the Respiration of Insects.* By E. Baudelot*.

The influence of the nervous system upon the respiration of Insects had attracted but little attention on the part of physiologists until, in 1860, M. Faivre undertook some interesting investigations upon this subject†.

The results of his researches led this naturalist to assume that in the *Dytici*, as in the Mammalia, the respiratory movements have their origin or starting-point in a special region of the

* Translated by W. S. Dallas, F.L.S., from the 'Comptes Rendus,' June 20, 1864, p. 1161.

† Annales des Sciences Naturelles, tome xiii.